Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 123 (2015) 32 – 40

Procedia Engineering

www.elsevier.com/locate/procedia

Creative Construction Conference 2015 (CCC2015)

Saudi Arabian aviation construction projects: Identification of risks and their consequences

Ahmad Baghdadi*, Mohammed Kishk

Scott Sutherland School of Architecture and Built Environment, Robert Gordon University, Aberdeen AB10 7QB, UK
Aberdeen Business School, Robert Gordon University, Aberdeen AB10 7QB, UK

Abstract

Airport projects are considered to be very complex, as they face a number of challenges which inevitably expose them to risks. In Saudi Arabia, the aviation sector is considered an important sector due to the fact that Saudi Arabia is the first destination for Muslims on an annual basis. As a result, the Saudi government has allocated a significant amount of its general budget to this sector through the General Authority of Civil Aviation (GACA). However, it has been found that these projects are still delivered with a significant number of time and cost overruns. These consequences are typically generated from the risks involved in the projects. Thus, the aim of this paper was twofold: first, to identify risks associated with aviation construction projects in Saudi Arabia and, second, to evaluate the consequences of these risks on a number of GACA projects. Critical literature reviews of common risks associated with aviation projects have been carried out. These were followed by 13 semi-structured interviews with expert project managers, including clients, contractors and consultants who have been involved in GACA projects. As a result, 54 new risks have been identified and classified into three levels: internal, external and *force majeure*. Results have confirmed the existence of time and cost overruns for GACA projects. The significance of the identified risks is currently being assessed and will be reported in a further paper.

Peer-review under responsibility of the organizing committee of the Creative Construction Conference 2015

Keywords: aviation construction projects; GACA; risks; risk management; Saudi Arabia

1. Introduction

Until the 1980s, there were only three airports in the Kingdom of Saudi Arabia (KSA) [1]. Currently, the number of airports in Saudi Arabia has increased to 26, including four international, eight regional and 14 domestic

* Ahmad Baghdadi. Tel.: +447450277261
E-mail address:a.m.a.baghdadi@rgu.ac.uk

Peer-review under responsibility of the organizing committee of the Creative Construction Conference 2015
doi:10.1016/j.proeng.2015.10.054

airports. As a result of this huge increase, the number of travellers has increased correspondingly (see Figure 1), and is expected to reach 100 million in 2020 [2]. The main aim of the General Authority of Civil Aviation (GACA) in Saudi Arabia, which plays the role of client representative (the Saudi government), is centred on facilitating the development of air travel by applying the strictest standards in the construction, management and operation of airports, and aeronautical navigation infrastructure and the maintenance of such systems [2].

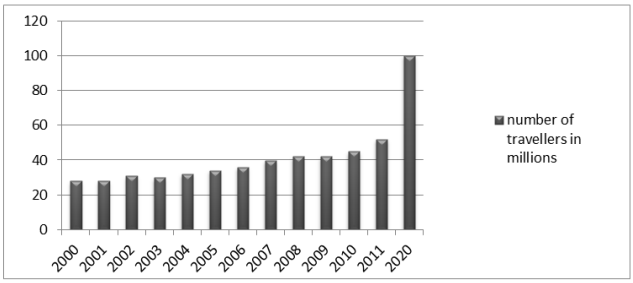

Figure 1: The number of travelers going through Saudi airports.
Source: The Saudi Arabian General Authority of Civil Aviation website, accessed April 14, 2013.

Among the different types of construction projects, airports projects are recognized as being some of the most complex [3]. Their importance comes from the fact that they represent a country's economy, development and production level [4]. Furthermore, there are challenges and difficulties involved within the construction industry, and the level of involvement is increased in the context of airport construction [5]. A number of studies have outlined and explained the challenges associated with airport projects, such as [6] and [7], among others. The following challenges are associated with Saudi Arabia's aviation projects (see Figure 2):

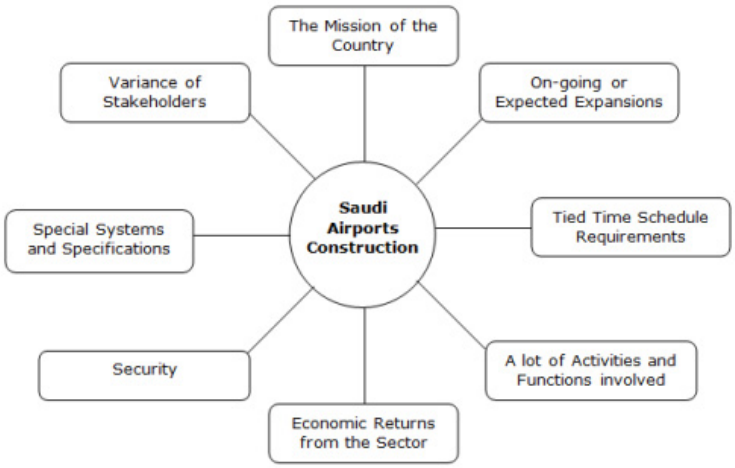

Figure 2: Challenges facing airport construction projects in Saudi Arabia Adopted from (Alnasseri *et al.*, 2013).

- Ongoing or expected expansion and renewal projects: A number of domestic, regional and international airports are undergoing expansion to increase their ability to face increasing demand [8].
- The variance of stakeholders involved, all of whom are very involved during the project lifecycle: As a result, the achievement of a consensus among these stakeholders is quite challenging [9]. This can be clearly seen in the context of Saudi aviation projects, especially in the ongoing Public Private Partnership (PPP) undertaken Project of Medina Airport, where a consortium of companies has been awarded the contract to build and operate the airport and then transferring it to the GACA after 25 years (the period of the concession agreement) [10].

- A wide variety of activities and functions are involved, which might force the design concept and specification of airports to be produced and prepared by an airport organization before the initiation of the construction process [6].
- The time schedule is crucial in aviation projects, with airport clients usually concerned with the completion time of the project.

Special systems and specifications: A number of systems can make airports more complex, such as sophisticated devices for security, electrical and data systems, distinct firefighting and alarm systems — all of which might add additional levels of complexity to the design and construction process [11].

Security in airports needs to be consistently high [5].

The mission of the country: As the KSA is considered the main destination for Muslims all over the world due to its two holy cities, Makkah and Medinah; it hosts millions of Muslims visiting the country to perform the Haj and Omrah (Islamic obligations) every year.

The aviation sector contributes SR 53.8 billion (1.8%) to the Saudi Arabian GDP [12].

These challenges can be directly contributing to the increased risks of airports construction projects in Saudi Arabia. Risks are typical reasons for delays or cost overruns that can occur in a project [13]. As a result, a number of time delays and cost overruns are found among different Saudi aviation construction projects. A report issued by [14] in 2011 revealed that the first phase of the new King Abdul Aziz International Airport in Jeddah would be completed in 2014. This is also stated in a report by [15]. However, until this time May 2015; phase 1 of the airport's construction is still ongoing and has not been handed over to GACA yet. Also, the most recent report claims that Araar domestic Airport will be handed to GACA in 2014. However, until now, the construction of the airport has not started yet for reasons unknown to the researcher. The tender for design and construction of Terminal 5 at Riyadh International Airport was awarded in May 2013 for the project completed within 18 months [16]. However, until this time May 2015; the project has not been handed over to GACA yet

Hence, the aim of this research that underpins this paper is twofold: first, to identify the risks associated with aviation construction projects in Saudi Arabia and second, to evaluate and confirm the consequences of these risks on a number GACA's projects in term of time delays and cost overruns. The rest of the paper is organized as follows; in the next section the topic related literature review which has been carried out is presented. Then, the methodology adopted in this paper is outlined. This is followed by the discussion of the results. Finally, conclusions are drawn and recommendations are introduced.

1.1. Literature review

Many authors have discussed the risks inherent in construction projects such as [17-29, and 30] among others, as details in Table 1.

Table 1: Studies and researches involved in the current study.

Author/s	Risk Classification	Risk Sub-Classification	# risks	Country	Type of construction project/s
ACRP Report 74 (2012)	Strategic, Human capital, Safety, Legal, Operational, Financial, Hazard, Technology	Not specified	45 risks	USA	Airport projects
Wang and Chou (2003)	-External -Internal	5 sub-classifications 3 sub-classifications	32 risks	Taiwan	Highway Projects

El-Sayegh (2008)	-Internal -External	3 sub-classifications	42 risks	UAE	Not specified
Ogunsanmi et al (2011)	Natural Phenomenon, Economics/Finance, Politics/society, Industrial characteristics, Contract, Construction, Job site, Safety/Environment, Client, Designer, and Contractor	3 sub-classifications	52 risks	Nigeria	Projects have been undertaken under Design and Build type of Procurement
Kartam and Kartam (2001)	Physical, Environmental, Design, Logistics, Financial, Legal, Political, Construction, Operation, and Contractual	Not specified	26 risks	Kuwait	Not specified
Khodeir and Mohamed (2014)	-Internal risks -External risks	-Economical -Political	63 risks	Egypt	Not specified
Zoue et al (2007)	Cost, Time, Quality, Environmental, and Safety	Not specified	85 risks	China	Not specified
Alnuaimi and Al Mohsin (2013)	-Design related -Construction related -Financial/ economic- -Management/Administrative -Regulations	2 sub-classifications 2 sub-classifications 2 sub-classifications 5 sub-classifications 1 sub-classification	49 risks	Oman	Not specified
Sweis et al (2008)	- Input Factors - Internal Environment -Exogenous Factors	3 sub-classifications 3 sub-classifications 2 sub-classifications	40 risks	Jordan	Residential projects
Assaf et al (1995)	Material, Manpower, Equipment, Financing, Environment, Changes, Government relations, Contractual relationship, Scheduling and controlling	Not specified	56 risks	Saudi Arabia	Large building projects
Al-Kharashi and Skitmore (2009)	Client, Contractor , Consultant , Materials, Labour, Contract, Relationship	Not specified	112 risks	Saudi Arabia	Public utility projects
Al-Khalil and Al-Ghafly (1999)	-Contractor performance -Owner administration -Early planning and design -Government regulations -Site supervision -Site and environmental conditions	5 sub-classifications Not specified Not specified Not specified Not specified Not specified	60 risks	Saudi Arabia	Public construction projects

Only one study [17] highlighted the risks inherent in airport projects. Forty-five risks have been identified and classified into eight different categories: strategic, human capital, safety, legal, operational, financial, hazard and technology [17]. Hence, due to the lack of literature regarding risks in the construction of airport projects, especially in Saudi Arabia, there was a need to review the risks associated with other construction projects, taking into consideration (where possible) their relevance to the project type and the location of these projects. Accordingly,

studies [18, 19, and 22] have established a risk structure for highway projects, unspecified projects and residential projects in Taiwan, the UAE and Egypt, respectively. The three studies share the same classification of risks, classifying the risks into two levels: internal and external. The internal level includes risks that fall under the control of the project management team, and the external level includes risks that fall outside the control of the project management team. These three studies also include further subclassifications of the risks in each of the two levels. The internal level includes risks generated from the projects' participants, such as the client, designer, contractor, subcontractor, and consultant. The external level includes risks which are generated by other factors, such as political, financial, social, and environmental factors and acts of god

Other different classifications of risks appear in study [20], which identifies 52 risks in Nigerian construction projects have been undertaken under design and build type of procurement. This study classified risks into 11 classifications and outlined the risks related to time delays, cost overruns and the poor quality of the studied projects. In another study involving unspecified Kuwaiti construction projects, [21] classified 26 risks into 10 main classifications: physical, environmental, design, logistics, financial, legal, political, construction, operation and contractual. Moreover, another classification appeared in a study conducted by [23] which involved unspecified construction projects in China. The authors of this study relied on five criteria to classify 85 identified risks: cost, quality, time, environment and safety.

In Saudi Arabia, four studies have been found that identify risks in a number of construction projects, including [26-29]. 56 risks have been identified by [26], which were then categorized into nine classifications based on the sources of the risks. A more recent study by [28] found 60 risks in public utility projects and classified the risks into six categories. This was followed by a well-established study by [29] outlining 73 risks in large construction projects. These risks were classified into eight categories based on the sources from which the risks could be generated: the project, owner, contractor, consultant, design, materials, labour and equipment. The most recent study on risks in public construction projects in the KSA was conducted in 2009 by [27], which identified 112 risks categorized into seven classifications — again taking into account the source of the identified risks.

2. Methodology

Two techniques have been used in this study. The use of a critical literature review of the common risks associated with airport projects and similar projects has been applied as the first step. Related-topic reports and statistics have also been reviewed. Subsequently, semi-structured interviews were conducted to verify the proposed structure risks by the researcher, and to evaluate and confirm the existence of overruns and delays in the cost and time of GACA's construction projects on a wider scale in term of different projects. Interviews have been used as a supporting technique to identify risks in construction projects in different studies such as [25, 26 and 28].

The 13 interviewees were selected based on their experience in GACA projects—10 years or more. Five interviewees are working for GACA, four interviewees from contractors and four interviewees from consultants who have all been involved in GACA projects. Also, the diversity of projects was a criterion for selecting the sample, as the interviewees have been involved in different projects of GACA's. The selected interviewees were asked a number of questions and given the chance to list any relevant risks they have encountered. The questions included the following:

1. What are the projects that you have been involved with GACA?
2. What was your role?
3. What are the major risks in the projects that you have been involved in GACA projects? (taking into consideration the initial proposed structure of the risks by the researcher)
4. What is the impact/s of the mentioned risk/s in the project you have been involved with GACA? To what extent do you measure the likelihood of these risks occurrences and impacts on the projects?

However, the conduction of the 13 interviews was obtained through the use of voice-recording technique, which enabled the data to be restored. Then, the data went through a number of processes in order to be analysed, including: typing and translating in/to English, as the majority of the interviews they were conducted in Arabic.

3. Results and Discussion

Relying on the studies mentioned in the literature review, the researcher looked at the risks that are thought to be related to the aviation sector in Saudi Arabia, risks inherent in construction projects in Saudi Arabia, risks inherent in construction projects in the Middle East (neighbouring countries), and risk inherent in global construction projects. Also, this study benefitted from the classifications and subclassifications outlined in previous studies (as discussed earlier in this paper). Accordingly, this research has proposed an initial structure of 44 risks inherent in GACA projects.

As a following step, conducting the 13 interviews has given the researcher the chance to verify the initial proposed structure of the risks, by the use of close-ended questions, where the interviewees were giving their opinions on the existence of each risk mentioned in the initial proposed structure in GACA projects they have been involved in. On the other hand, the use of open-ended questions, as their advantages of opening a dialog with the interviewee, were utilized in order to allow the interviewees from the three different groups to comment on: the initial proposed structure of risks, in terms of adding or removing risks to/from it, and the existence of time delays and cost overruns in GACA's projects in a wider scale, as the major focus of the literature on international airports.

As a result of a simple descriptive statistical analysis that was performed to present the risks that were mentioned frequently by the interviewees, 54 risks have been outlined; the interviewees added 10 risks (written in red in Table 2) to the initial proposed structure of risks, which contained 44 risks (written in black in Table 2). These risks have been classified into three levels: an internal level consisting of risks that fall within the control of projects' participants as they are the ones who generate the risks; an external level consisting of risks that partially fall outside the control of projects' participants but where they have some influence to control them; and, finally, *force majeure* risks, consisting of risks that are outside the control of any project party. Each of these levels of risks is subsequently classified into a number of subclassifications based on their source. The classifications and subclassifications of the identified risks are used in this study in order to facilitate the process of analysing the risks in a further study. Hence, for the first level of risks (internal), five sources of risks have been outlined—client, designers, contractors, subcontractors and consultants—as those represent the main participants in GACA's construction projects. On the other hand, the external risk level consists of four sources of risks: political, social, financial and natural risks. Lastly, the *force majeure* risk level consists of two sources of risks: natural phenomena and weather issues that are not within any project participants' control.

Table2: The proposed structure of risks inherent in GACA construction projects.

A. Internal Risks
Client-specific risks:
1. Payment delays
2. Tight schedule set by client
3. Inappropriate intervention by client
4. Design changes by client
5. Inadequate scope
6. Site access delays
7. Contract breaching by client
8. Client financial failure
23. Low or poor contractor work productivity
24. Errors during construction
25. Accidents and safety issues
26. Quality and control assurance
27. Contractor breaching by contractor
28. Project type know-how skills
29. Inadequate risk management plan
Subcontractor specific risks:
30. Poor subcontractor work productivity
31. Subcontractor breaching contract
Social risks
45. Crime rate
46. Cultural differences
Financial risks
47. Inflation
48. Currency fluctuation
Natural
49. Poor site conditions
50. Pollution
C. *Force Majeure* Risks

9. Lack of experience of client
10. Obtaining/issuing required approval
11. Issue of sustainability
12. Inadequacy of requirements
13. Poor coordination
14. Changing demands

Designer-specific risks:

15. Design errors
16. Incomplete design
17. Design constructability
18. Poor quality of design
19. Project type know-how skills

Contractor-specific risks:

20. Poor quality of construction
21. Lack of experience of contractor
22. Contractor financial failure
32. Subcontractor financial failure
33. Material availability
34. Material quality
35. Project type know-how skills

Consultants specific risks:

36. Inadequacy of specifications
37. Lack of experience
38. Quality assurance
39. Project type know-how skills

B. External Risks

Political risks

40. Bureaucratic problems
41. Threat of war
42. Labour issues
43. Corruption
44. Changes to laws

Natural phenomena

51. Earthquakes
52. Fires
53. Floods

Weather issues

54. Severe weather conditions

However, among the 54 identified risks, there were five risks mentioned by at least two interviewees from each group. These risks have been quantitatively analysed by the use of descriptive statistical analysis (Frequency of occurrence technique):

• Inadequate Scope

This risk was mentioned by 100% of the client interviewees, 50% of the contractor interviewees and 75% of the consultant interviewees. This result seems to comply with one study that concluded “a recent report by [30] found that some construction industry officials consider lack of scope definition to be the most serious problem on construction projects”.

• Payment Delays

This risk was mentioned by 60% of the client interviewees, 50% of the contractor interviewees and 100% of the consultant interviewees. Although this is typically a risk generated by the client, and it is normally caused due to difficulties with client cash flow [31], this does not seem to be the case in all GACA projects that have experienced payment delays.

• Design Changes

This risk was mentioned by 60% of the client interviewees, 100% of the contractor interviewees and 75% of the consultant interviewees. There are a number of reasons why changes in designs occur. Some of the reasons have been mentioned by [32], and these include errors in design documents, changes of requirements by the client or changes in the site condition. In the case of GACA projects, there are frequent requests for design changes, according to the interviewees.

• Bureaucratic Problems

The risk of bureaucratic problems was mentioned by 60% of the client interviewees, 50% of the contractor interviewees and 50% of the consultant interviewees. Recent results from a symposium held at the OKAZ Newspaper head office in 2013, one of the most well-known newspapers in Saudi Arabia, about delays in infrastructure projects in that country, confirmed that bureaucratic barriers are a major issue that might hinder a project.

• Changing demands

The risk of changing demands was mentioned by 100% of the client interviewees, 50% of the contractor interviewees and 75% of the consultant interviewees. The issue of GACA changing the types of their projects (mainly at domestic airports) is obvious, as indicated by the interviews conducted.

As the interviews were also used to evaluate time delays and cost overruns which occurred in GACA's construction projects, some interviewees mentioned the number of time delays and cost overruns encountered in the GACA projects in which they have been involved. Table 3 shows some of GACA's construction projects and their types (domestic, regional or international), that have been affected by time delays and cost overruns. The existence of time delays and cost overruns, which have been confirmed by the conducted interviews, has validated what has been said about the effects of risks on construction projects by [3]. It also stresses the need to manage risks properly, which highlights the need for a proper analysis of the identified risks in terms of their likelihood of occurring and their effects.

Table 3. The GACA construction projects that have encountered time delays and cost overruns.

The Project	Project Type	The Impact
Jizan Airport	Regional	Late start of the project (Time delay)
Hail Airport	Regional	Several stops (Time delay)
Najran Airport	Domestic	Quality of the project
Construction of Al-Qassim Airport (Stage 2)	Regional	Six-month delay in project delivery (Time delay)
Construction of Al-Qassim Airport (Stage 3)	Regional	Six-month delay in project delivery (Time delay)
Design of Al-Qassim Airport	Regional	10% added to the total cost (cost overrun)
		Four-month delay in project delivery (Time delay)
Development and enhancement of a number of airports (Stage 3), including: 1. An expansion of Al-Taif Airport 2. An expansion of Hail Airport 3. An expansion of Jizan Airport	Domestic	12-month delay in project delivery (Time delay)
Jizan Airport	Regional	Late start of the project (Time delay)
Al-Qassim Airport	Regional	Delay in project delivery (Time delay)
King Abdulaziz Airport	International	Late start of the project (Time delay)
		Cost overruns
Hafer Albaten Airport	Domestic	Delay in project delivery (Time delay)
Al-Jawf Airport	Domestic	Late start of the project (Time delay)
Alqassim Airport	Regional	Late start of the project (Time delay)
Araar Airport	Domestic	Delay in project delivery (Time delay)

4. Conclusion

A structure of the risks that are inherent in GACA projects has been introduced by this study. This was done through the use of a critical literature review and semi-structured interviews with experts who have been involved in GACA projects, including clients, contractors and consultants. The structure contains 54 risks classified into three levels: internal, external and acts of god. Then, the risks were subclassified into the sources of each risk. The reason for such a classification is to facilitate the analysis of these risks in a further work. Also, the results revealed that a number of domestic, regional and international GACA projects have encountered time delays and cost overruns, which are typical outcomes from the risks inherent in these projects. Although five risks were found to have been mentioned by at least two interviewees from each group, including design changes, changing demands, payment delays, bureaucratic problems, and inadequate scope, the researcher suggests that there is the need to quantitatively determine the importance of the 54 identified risks in terms of their likelihood of occurring and their effects on GACA projects. Hence, the remaining work of the ongoing study will be focusing on the quantifying the identified risks in term of their likelihood of occurring and their effects on GACA projects by the use of questionnaires as a

means for collecting data; in order to come up with a proper solution to enhance the current practice of allocating risks (the aim of the main research) within the abovementioned context.

Acknowledgements

This study is a reporting part of a current PhD, undertaken at Robert Gordon University, which aims to develop a framework to properly allocate risks associated with Saudi Arabian aviation construction projects.

References

[1] AL-JARALLAH, M.I., 1983.Construction industry in Saudi Arabia. *Journal of Construction Engineering and Management,* 109(4), pp. 355-368

[2]The Saudi GENERAL AUTHORITY OF CIVIL AVIATION WEBSITE, 2013. *Http://www.gaca.gov.sa*. [Online] accessed April 14th, 2013.

[3] NASSIM, M.G. and MAHMOUD, E.H., Managing Airports' Construction Projects, An Assessment of the Applicable Delivery Systems.

[4] Kapur. A. (1995). *Airport Infrastructure. The Emerging Role of the Private Sector.* Washington D.C.

[5] ALNASSERI, N., OSBORNE, A. and STEEL, G., 2013. Managing and Controlling Airport Construction Projects: A Strategic Management Framework for Operators. *Journal of Advanced Management Science Vol,* 1(3),

[6] Adrem, Anders, et al. (2006), "Managing airports construction projects."

[7] F. Binnekade, R. Biciocchi, B. E. O'Rourke, and C. Vincent, *Creating Smarter Airports: An Opportunity to Transform Travel and Trade.* USA: IBM, 2009.

[9] T. G. Flouris and D. Lock, *Managing Aviation Projects from Concept to Completion*, U.K.: MPG Group, 2009.

[11] Engineering News-Recod Magazine, 2013, http://enr.construction.com/. [Online] accessed February 10th, 2014.

[12] Oxford Economics Report, 2011. http://www.oxfordeconomics.com/. [Online] accessed February 10th, 2014.

[13] Akintoye, A. S. & MacLeod, M. J. (1997) Risk Analysis and Management in Construction. International Journal of Project Management.

[15] Kuwaiti Finance House Research Ltd (2013). Saudi Arabia Infrastructure "Projects Galore".

[17] Airport Cooperative Research Program. Report 74 (2012). The Federal Aviation Administration. Transportation Research Board, USA.

[18] WANG, M. and CHOU, H., 2003. Risk allocation and risk handling of highway projects in Taiwan. *Journal of Management in Engineering.*

[19] EL-SAYEGH, S.M., 2008. Risk assessment and allocation in the UAE construction industry. *International Journal of Project Management.*

[20] OGUNSANMI, O.E., SALAKO, O. and AJAYI, O.M., 2011. Risk Classification Model for Design and Build Projects. *Journal of Engineering, Project & Production Management,* 1(1),

[21] KARTAM, N.A. and KARTAM, S.A., 2001. Risk and its management in the Kuwaiti construction industry: a contractors' perspective. *International Journal of Project Management,* 19(6), pp. 325-335

[22] Khodeir, L. M., & Mohamed, A. H. M. (2014). Identifying the latest risk probabilities affecting construction projects in Egypt according to political and economic variables. From January 2011 to January 2013. *HBRC Journal*.

[23] Zou, P. X., Zhang, G., & Wang, J. (2007). Understanding the key risks in construction projects in China. *International Journal of Project Management*.

[24] Alnuaimi, A. S., & MOHSIN, M. (2013). Causes of Delay in Completion of Construction Projects in Oman. In *International Conference on Innovations in Engineering and Technology* (pp. 267-270).

[25] Sweis, G., Sweis, R., Hammad, A.A., and Shboul, A. (2007). "Delays in construction projects: The case of Jordan." *Int. J. Project Management*, Article in Press.

[26] Assaf, S. A., Al-Khalil, M., & Al-Hazmi, M. (1995). Causes of delay in large building construction projects. *Journal of management in engineering*, *11*(2), 45-50.

[27] Al-Kharashi, A., & Skitmore, M. (2009). Causes of delays in Saudi Arabian public sector construction projects. *Construction Management and Economics*.

[28] Al-Khalil, M. I., & Al-Ghafly, M. A. (1999). Important causes of delay in public utility projects in Saudi Arabia. *Construction Management & Economics*.

[29] Assaf, S. A., & Al-Hejji, S. (2006). Causes of delay in large construction projects. *International journal of project management*, *24*(4), 349-357.

[30] Construction Industry Institute website, Accessed 19th November 2014).

[31] Sambasivan, M., & Soon, Y. W. (2007). Causes and effects of delays in Malaysian construction industry. *International Journal of project management*, *25*(5), 517-526.